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INSPECTION STANDARDS FOR BITUMINOUS-COAL
AND LIGNITE MINES
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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

INSPECTION STANDARDS FOR BITUMINOUS-COAL AND LIGNITE MINES^{1/}

Revised July 1945

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^{1/} The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7333."

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INTRODUCTION

The revised inspection standards or recommendations herein have been prepared for use in Federal inspection of bituminous-coal and lignite mines. They succeed a compilation of similar standards published as Bureau of Mines Information Circular 7268 in December 1943 and employed as a guide in Federal inspections since that time. Important alterations and additions have been made because of changes in mining practice and temporary shortages of some safety equipment; moreover, several previous standards have been found not generally applicable and have accordingly been deleted.

Mining methods and equipment continue to change, and new hazards and new safeguards are introduced. Consequently, these standards are subject to revision from time to time. Questions from the coal-mining industry regarding these standards and suggestions as to changes and additions thereto will be welcomed and considered carefully when the next revision is made. Many constructive criticisms from the mining industry have been considered in preparing this edition.

Certain standards go beyond provisions of the various State mining laws, and others may conflict with the laws or safety orders of some States. When such conflict occurs, the intent is not to advocate noncompliance with State laws or orders but to suggest consideration of their revision.

Although effort has been made to word these standards so that they may be readily understood, a reasonable interpretation should be placed upon them. In numerous instances the words "reasonable," "suitable," and "properly," are used because reason and sound judgment are vital in carrying out safety endeavor.

Any unusual hazard noted by an inspector and not covered by these standards will be discussed in the inspection report and an effort made to offer suitable recommendation for its elimination.

Wherever certified officials, such as certified fire bosses, are mentioned in these standards, officials certified by the State are meant. If

the State requires no certification for such officials, they should be men well-versed in the duties of their positions through mining experience and training, and such positions should be designated in writing by the management. In the interest of safety, the Bureau of Mines believes that State certification of mine officials is desirable.

1. SURFACE STRUCTURES

Tipple and Cleaning Plant

1.01 To minimize fire and coal-dust-explosion hazards:

- a. Electric motors, switches, and controls used in tipples and cleaning plants should be of dusttight construction.

NOTE: The procurement of dusttight motors under war conditions to replace open-type motors that are not dusttight may be difficult or impossible. The inspector will take cognizance of this difficulty by recommending that any replacements or additions to the present tipple motors should be dusttight if possible to obtain them and that measures should be taken to minimize the possibility of dust accumulations or dust clouds about motors.

- b. Stoves or other heating devices should be properly and safely installed and of a type to meet these purposes.
- c. Coal dust should be thoroughly cleaned from the tipple frequently and, if possible, daily. If it is impracticable to remove coal dust from remote places, such places should be rock-dusted.
- d. Coal dust should be allayed with water or other wetting agent at points where large quantities of dust are released, or a dust-collecting system should be installed at such points.
- e. Where coal is dumped at or near air-intake openings, provision should be made to prevent the dust from entering the mine.
- f. Coal dust should be kept from accumulating in or about any surface building.

1.02. Welding in tipples or cleaning plants should be done preferably when the plant is idle; welding should not be done in a dusty atmosphere; a fire extinguisher should be readily available; and combustible surroundings should be wetted down before and after welding.

1.03. Where coal is treated with oil, men exposed to the oil mist should wear permissible respirators, affording protection against fume and mist, and sources of ignition should be kept at safe distances from the oil spray.

Steam and Compressor Plant

1.04. All boilers should receive at least one internal inspection annually by an authorized inspector, and a written record of such inspection should be kept.

1.05. A safety-valve escape should not discharge lower than 7 feet off the floor; preferably the discharge should be piped to the outside of the building.

1.06. At least two safe means of exit from the boiler room should be available, and any doors should open outward.

1.07. A stairway or fixed ladder should be provided to give easy access to the top of boilers or runways between boilers.

1.08. Compressed-air receivers should be protected with safety or relief valves.

1.09. Compressed-air receivers should be inspected at least annually by a competent person, and a written record of such inspection should be kept.

1.10. Gages should be provided for boilers and compressors (steam pressure, air pressure, water, etc.)

Wash House

1.11. Where wash houses are provided, they should be:

a. Provided with showers and an adequate supply of hot and cold water.

b. Kept clean and sanitary.

c. Provided with at least two exits.

d. Well-illuminated.

e. Provided with clothes lockers or hangers.

f. Kept well-heated and, if necessary, heating equipment guarded against contact hazard.

g. Properly ventilated.

h. Provided with adequate facilities to prevent the spread of foot infection. If foot baths are used, the disinfectant should be changed daily.

i. Provided with sanitary toilet facilities.

Supply House

1.12. Material should be stored so that it will not fall or cause a stumbling hazard.

1.13. If oil or grease is stored in a building, the building should be of fire-resistant material and provided with a ventilator extending to near the floor level.

1.14. Oil, grease, and similar flammable materials should be stored in closed containers separate from other materials and in such manner so as not to create a fire hazard to nearby buildings or mine.

Lamp House

1.15. Charging equipment should be guarded and protected against shock and fire hazards.

1.16. Naphtha kept in a lamp house for use in flame safety lamps should be either in an approved container or in some other safe dispenser.

1.17. Flame safety lamps should be of permissible type.

1.18. Flame safety lamps should be properly cleaned and assembled by a lamp attendant or a competent person before each period of use. The lamp assembly should again be thoroughly checked by the person using the lamp immediately before he enters the mine.

1.19. When not in service, all methane indicators or detectors and flame safety lamps should be in the custody of a competent person responsible for maintenance and testing.

Stairways, Ladders, and Platforms

1.20. Surface stairways should not be set on an angle of more than 45° with the horizontal.

1.21. Stairways should be provided with safe handrails and kept in good repair.

1.22. The treads of stairways should present a minimum slipping hazard and be of uniform construction and spacing.

1.23. Clearance over stairways should be at least 6-1/2 feet; where such clearance is not feasible, a conspicuous warning sign should be displayed.

1.24. Permanent ladders should be provided with guards if necessary.

1.25. Platforms, elevated walkways, and openings in floors should be provided with toeboards and railings.

1.26. A railed platform should be provided at head sheaves.

1.27. The stairway leading to the sheave platform should be provided with a handrail.

Housekeeping, Illumination, and Heating

1.28. Good housekeeping should be practiced. In addition to orderliness in storing materials and cleanliness of buildings, good housekeeping includes the removal of possible sources of injury, such as protruding nails and broken glass.

1.29. Surface buildings should be well-lighted and heated, if necessary.

2. HOISTING, CAGES, AND SHAFTS

Hoisting

2.01. Machinery should be so placed that the noise from it will not prevent the hoisting engineer from hearing signals.

2.02. A hoisting engineer should be physically fit and should undergo a physical examination at least annually to determine his continued fitness. The physician's report of such examination should be posted.

2.03. Hoists used for handling men should be equipped with automatic overwind, overspeed, and automatic stop controls, unless a second engineer is in attendance.

2.04. At the beginning of each shift, and after the hoist has been idle for an extended period, the hoisting engineer should operate the cages up and down the shaft at least one round trip before hoisting or lowering men. Similar procedure should be followed in slope hoisting.

2.05. Hoists should be equipped with brakes capable of stopping and holding the fully loaded unbalanced cage or trip of cars at any point in the shaft or on the incline.

2.06. An accurate and reliable indicator of the cage or trip position should be so placed as to be in constant view of the engineer.

2.07. Drum guides or flanges should be high enough to extend at least 4 inches above the rope at any time.

2.08. Hoisting equipment should be inspected daily and a record made of such inspection.

2.09. Sheaves should be inspected daily and kept properly lubricated. The hoisting engineer should be advised when the inspection is completed.

and a record made of this inspection. The hoist should not be operated during the inspection.

2.10. A hoisting rope should be adequate in size to handle the load with the proper factor of safety as defined in wire-rope standards, and the rope should be replaced as soon as there is evidence of undue weakness or other conditions which indicate that it may fail.

2.11. The rope, when extended to its maximum working length, should make at least three full turns on the drum and should make at least one full turn on the drum shaft or around a spoke of the drum (in case of a free drum); the end of the rope should be fastened securely by means of clamps.

2.12. The rope should be fastened to its load by a spelter-filled socket, a thimble and clamps, or a thimble splice.

2.13. Cages on which men are transported should be provided with bridle chains.

2.14. A rope should not be used for hoisting men:

- a. Which shows more than six broken wires in any single pitch length or lay of rope.
- b. When the wires in the crown of the strand are worn to less than 65 percent of their original diameter.
- c. When inspection indicates a dangerous amount of corrosion or distortion.

2.15. A record should be kept of the length of service of, and tonnage hoisted by, all hoisting ropes.

2.16. Ropes, links, chains, and rope sockets should be examined carefully at least every 24 hours by a competent person and a record kept of such inspections.

2.17. Rollers used on slopes or inclines should be of sufficient length, properly alined, and kept in good repair.

2.18. At least two independent methods of signaling, one of which should be audible, should be provided on all landings in shafts or slopes.

2.19. One of the signal devices at the surface and at each landing should be so located that it can be reached from the cage or car.

2.20. The signal code in use at the mine should be posted prominently in the engine room in easy sight of the hoisting engineer and at all places where signals are given.

Cages and Shafts

2.21. Cages used for hoisting men should be of substantial construction, kept in good repair, and provided with:

- a. Adequate steel bonnets.
- b. Enclosed sides.
- c. Gates across ends when men are being hoisted or lowered.
- d. Handholds.

2.22. Cage safety catches that act quickly and effectively in an emergency should be provided; they should be inspected daily and a drop test made at least every 2 months. A written record should be kept of inspections and tests.

2.23. Cages and hoisting shafts should be inspected daily and a record kept of such inspections. Guides should be maintained in good repair.

2.24. Any opening in the cage floor should be covered, and any movable parts of the cage platform should be secured when men are being handled.

2.25. A cager should be in charge at the top and at the bottom of the shaft when men are transported.

2.26. Shafts should be equipped with safety gates at landings. The gates should be self-closing and so constructed that men and materials cannot fall through or under them into the shaft.

2.27. Positive stopblocks or derails should be placed near shaft landings.

2.28. Tools or other material should not be carried in the cage with men; however, this should not apply to equipment and material requiring attendants.

2.29. The speed of cage when hoisting or lowering men should not exceed 900 feet a minute.

2.30. A run-around should be provided for travel at the foot and at all intermediate landings of hoisting shafts. The run-around should not be less than 5 feet high and 3 feet wide.

2.31. All workmen should wear safety belts while engaged in repair work in or above shafts. When a platform is being used, the cage or a second safety platform should be placed not more than 10 feet beneath the working platform.

3. MISCELLANEOUS SURFACE CONDITIONS

Mine-Refuse Disposal

3.01. Mine waste should be so stored as to minimize fire, fume, or slide hazards.

3.02. If workers on waste dumps may be exposed to serious fume hazards, permissible universal gas masks should be immediately available.

3.03. Waste dumps should be fenced where there is a hazard to persons, especially children.

3.04. **Persons** should not be permitted to live or work in buildings imminently endangered by fire, fume, or slide hazards from waste dumps.

Yards and Storage of Material

3.05. Timbers, ties, and other mine lumber, other than 1 day's supply, should not be kept within 100 feet of any mine opening or mine fan; and all materials, including rails and scrap iron and other scrap, should be properly stored and piled so that they will not obstruct roadways, will not present stumbling hazards, and will not roll or fall.

3.06. Roads, paths, and walks should be kept free of obstructions and should be well-illuminated if used by night shifts.

Surface Fire Prevention

3.07. Buildings and other structures within a radius of 100 feet of mine openings should be of fireproof or fire-resistant construction. If existing buildings within 100 feet of openings are not of fireproof or fire-resistant construction, fire doors should be erected at effective points to prevent smoke or fire from outside sources endangering men working underground. These doors should be tested at least monthly to assure effective operation.

3.08. Adequate fire-fighting equipment should be provided. This equipment (suited to the size and type of surface plant), such as hydrants, hose and nozzles, chemical trucks, fire extinguishers, and barrels filled with water, should be readily accessible and its location plainly marked.

3.09. Fire-hydrant couplings should be standard and interchangeable with those of available municipal fire departments, or suitable adapters should be provided.

3.10. Fire-fighting equipment should be inspected and tested at least every 6 months and a record made of such inspections.

3.11. A fire-fighting organization should be maintained and, if feasible, fire drills held at least twice a year.

3.12. Tight metal receptacles should be provided for oily waste.

3.13. Smoking in or about surface structures should be restricted to places where it will not create a fire or explosion hazard.

4. METHODS OF MINING AND TIMBERING

4.01. Methods of systematic face timbering, suitable to the roof conditions, should be adopted at each mine and a plan posted. These should be considered the minimum requirements, irrespective of the firmness of the roof, and additional timbering should be provided where roof is hazardous.

NOTE: This standard is not applicable in those rare instances, such as tunnels in solid rock, where roof conditions are such that experience has shown that little or no timbering is required.

4.02. Timbering methods should be strictly enforced.

4.03. An adequate supply of props, timbers, and prepared cap pieces and wedges should be provided convenient to the faces and other places of use.

4.04. Face workers and other employees exposed to roof hazards should examine their places thoroughly before beginning work. Any dangerous conditions should be corrected before regular work is started.

4.05. Every underground worker should be instructed in the sound and vibration methods of testing roof.

4.06. Exposed roof, ribs, faces, and overhanging brows at every active working face should be tested at frequent intervals.

4.07. Loose coal or rock in places where men are required to work or travel should be removed or supported as soon as detected, and no person should go under such loose material until it is made safe.

4.08. Mining-machine and loading-machine operators should be provided with suitable roof-testing rods and should test the roof and sides; any dangerous condition should be remedied before the machines are taken in by the last permanent timbers. Machines should be stopped while the roof and sides are being tested.

4.09. Officials should test exposed roof in working places visited and roof along the haulageways and manways with a special roof-testing rod; condition of timbering should also be determined.

4.10. Before loose roof is taken down, the adjacent roof should be examined carefully; if the conditions warrant, a temporary post or posts should be set first.

4.11. If loose roof material is being pried down, a bar not less than 4 feet long should be used instead of a pick or a short-handled tool.

4.12. Temporary safety posts, jacks, or cross bars should be set before other mining operations are begun.

4.13. The roof should be examined carefully before safety posts or cross bars are removed. Where necessary, additional timbers should be set. If any safety posts are removed before additional timber is set, a long bar or rail rather than a hammer or ax should be used in removing them.

4.14. Where there is danger that coal will roll upon a person during or after under cutting or center cutting, it should be spragged by placing blocks in the cut or by blocking with leaning posts.

4.15. In slopes or inclined shafts and in the main haulageways, legs supporting cross bars should be hitched into the rib or wall. If this is not practicable, substantial guardrails should be placed along, or spacers placed between, the legs.

4.16. Posts should be set with cap pieces of adequate thickness and length and at least as wide as the top of the post. Wedges should be used between the posts and the cap pieces if necessary. Preferably, prepared cap pieces should be provided.

4.17. In hand-loading places where permanent cross bars or posts are required, temporary timbers should not be extended more than the distance of one "cut" of coal beyond the last permanent cross bars or posts.

4.18. In mechanical-loading places where temporary cross bars or posts are required to be set close to the face, such temporary cross bars or posts should not be removed until permanent cross bars or posts have been set to replace them; no more than two "cuts" of coal should be removed beyond the last permanent cross bar or post.

4.19. Broken or rotten timbers should be replaced as soon as possible.

4.20. Timber removed by cutting-machine or loading-machine operators or timber knocked out by shooting should be replaced as soon as possible.

4.21. Timbers should be recovered from worked-out sections only by mechanical means, by men experienced in such work, and under the direct supervision of an official.

4.22. In pillar work, breakline posts or cribs should be maintained at the loose ends of pillars and stumps.

5. EXPLOSIVES, DETONATORS, AND BLASTING DEVICES

Surface Explosives and Detonator Magazines

5.01. Separate surface magazines of proper construction should be provided for the storage of explosives, detonators, and heater elements.

NOTE: For proper construction see Federal Explosives Regulations.

5.02. a. High explosives (permissible explosives or dynamite), in amounts exceeding 125 pounds, should be stored in permanent magazines.

b. High explosives, in amounts of 125 pounds or less, may be stored in permanent magazines as provided in (a). If not so stored, such explosives should be stored in box-type magazines.

c. Black powder, in amounts exceeding 125 pounds, should be stored in permanent magazines.

d. Black powder, in amounts of 125 pounds or less, may be stored in permanent magazines as provided in (c). If not so stored, it should be stored in box-type magazines.

e. Detonators, in numbers of more than 5,000, should be stored in permanent magazines.

f. Detonators, in numbers of 5,000 or less, may be stored in permanent magazines as provided in (e). If not so stored, they should be stored in box-type magazines.

g. The floor of magazines should be constructed of nonsparking materials, preferably wood, with no exposed metal.

h. Magazines should be kept locked securely when unattended.

5.03. Magazines used for distributing explosives or detonators should be of the same type of construction as storage magazines and situated not less than 200 feet from any mine opening or vital structure. Not more than 1 day's supply of explosives should be kept in a distributing magazine.

5.04. a. The location of permanent explosives-storage magazines should conform to the amended American Table of Distances insofar as feasible. Where the magazine location does not conform to these requirements, and relocation is not practicable, effective barricades should be constructed as conditions permit.

b. Permanent explosives-storage magazines should not be closer than 200 feet from any vital structure, or from any mine shaft, tunnel, or slope opening to the surface.

c. Permanent magazines should be located a safe distance from waste dumps and on suitably drained sites.

d. Permanent detonator-storage magazines should be not less than 100 feet, not barricaded, or 50 feet, barricaded, from a permanent explosives-storage magazine.

5.05. The area surrounding the magazine for not less than 25 feet, preferably 50 feet, in all directions should be kept free of rubbish, dry grass, or other material of a combustible nature; preferably, this area should be covered with some material to prevent the growth of grass, brush, and weeds.

5.06. The premises on which a permanent magazine is located should be marked conspicuously by signs containing the words "EXPLOSIVES--KEEP OFF." Such signs should adequately warn any person approaching the magazine of the presence of explosives, but the signs should not be placed as to direct general public attention to the location of the magazine. No signs should be placed on surface magazines or barricades or be so located that a bullet passing directly through the face of the sign will strike the magazine. Box-type magazines and operation storage boxes should be marked clearly with the word "EXPLOSIVES."

5.07. If the explosives magazine is illuminated electrically, the lamps should be of explosion-proof type, installed and wired in accordance with the National Electrical Code. The switch should be outside the building, and wiring should be in conduit.

5.08. Detonators, Cardox heater elements, tools, or materials other than explosives should not be stored in an explosives magazine, except that safety and detonating fuse may be stored in any explosives or detonator magazine. If not so stored, safety fuse should be kept in locked containers, locked rooms, or otherwise adequately protected against theft.

5.09. Unauthorized persons should not be permitted in any magazine.

5.10. Only hardwood or nonmetallic tools should be used for opening wooden containers of explosives or detonators. In opening cardboard containers of explosives with a knife or other cutting tool, care should be taken to avoid cutting the explosive.

5.11. Waste paper, empty containers, or other combustible material should not be allowed to accumulate in explosives or detonator magazines.

5.12. Smoking, carrying smokers' articles, or open flame should not be allowed in or near any magazine, or while explosives or detonators are being handled.

5.13. Containers of explosives or detonators should always be lifted and set down carefully, never slid over one another or dropped from one level to another.

5.14. New explosives should be piled in a magazine in such a manner that the explosives previously stored will be used first, thus preventing possible deterioration.

5.15. Deteriorated or damaged explosives or Cardox heater elements should be destroyed. Explosives and detonators should be destroyed only by a person who is experienced in this work, preferably a technical representative of a manufacturer of explosives.

Surface Transportation

5.16. Vehicles used in surface transportation of explosives or detonators should be constructed substantially and maintained in good working order. Any exposed metal on the inside of the body that might come in contact with any package of explosives or detonators should be covered or protected with wood or other nonmetallic material. Explosives in open vehicles should be covered with tarpaulins.

5.17. State or other regulations as to marking vehicles transporting explosives should be followed. If no laws or regulations are in effect, any such vehicle should be placarded on the front, each side, and the rear with the word EXPLOSIVES in letters not less than 3 inches high or should display a red flag with the word DANGER in white letters not less than 6 inches high.

5.18. Unauthorized persons should not be permitted to ride on vehicles transporting explosives, and the driver and helper should neither smoke nor carry matches or lighters.

5.19. A vehicle containing explosives should never be left standing or unloaded without first stopping the motor and setting the brakes securely and should never be taken into a garage or repair shop. Explosives cases should never be left immediately back of the exhaust, as a spark may start a fire or cause an explosion.

5.20. Explosives or detonators should never be left unattended on the surface unless they are in locked magazines.

5.21. Records should be kept of all explosives, detonators, and Cardox heater elements received, stored, and used.

Cardox Storage and Charging Station

5.22. A Cardox charging station should:

- a. Be in a fireproof structure on the surface.
- b. Be in a detached building or isolated from other operations in the same building by a substantial fireproof partition.

- c. Have all electric equipment grounded.
- d. Have permanent storage tanks at least 200 feet from any mine opening, preferably at lower elevation.
- e. Be provided with at least two methods of relieving excess pressure in the storage tank. If one of these methods is a valve, the valve should be tested monthly.
- f. Have a box-type magazine for storing the daily supply of heater elements.

5.23. A separate magazine should be provided for the storage of heater elements. It should be not less than 100 feet, not barricaded, or 50 feet, barricaded, from other buildings.

Underground Transportation

5.24. Individual containers used to carry explosives or detonators into mines should be constructed substantially of rigid nonconductive material (such as wood, plastic, or pressed fiber). Containers should be closed and maintained in good condition.

5.25. When explosives or detonators are transported underground by locomotive, rope, shuttle car, or animal, they should be in covered cars or specially designed containers.

- a. If there are energized electrical conductors on the haulageways, the bodies and covers of such cars should be constructed substantially of nonconductive material and should be fully insulated. When cars contain explosives or detonators, they should be locked or attended at all times.
- b. Specially designed containers should be of wood 1-1/2 inches or more in thickness or of equivalent rigid, substantial construction; they should be fully insulated and locked securely when not attended.
- c. If explosives and detonators are hauled in the same explosives car or in the same specially designed container, they should be separated by at least a 4-inch, substantially fastened hardwood partition or the equivalent.

5.26. Explosives and detonators should be transported underground by belt only under the following conditions:

- a. In the original, unopened wooden cases or in insulated, rigid containers of wood 1-1/2 inches or more in thickness, or of equivalent substantial and insulated construction, or in suitable individual containers.

- b. There should be a minimum clearance of 6 inches above the containers of explosives or detonators. There should be not less than 30 inches of side clearance on the "wide" side and 12 inches of clearance on the "tight" side of belts.
- c. Suitable loading and unloading stations should be provided.
- d. There should be an attendant at loading and unloading points and stop and start controls at these points.
- e. The belt speed should be such as to minimize danger of explosives or detonators dropping off belts in transit and such as to permit quick stopping of the belt for loading and unloading purposes and in case of emergency.
- f. An interval of at least 50 feet should separate explosives and detonators. They should not be transported past tributary belts or other equipment protruding over the belt unless an attendant is on duty at such points.

5.27. Explosives or detonators should not be transported on flight or shaker conveyors or by scraper loaders.

5.28. When feasible, the supply of explosives should be delivered on the off shift or between shifts.

5.29. Explosives or detonators should not be carried on the same trip with workmen.

5.30. Trips carrying explosives should not be hauled into or out of a mine within 5 minutes preceding or following man-trips; when traveling with the air current, the explosives trip should precede; if against the air current, the man-trip should precede.

Underground Storage

5.31. Individual portable containers for explosives and detonators should be stored in niches in the rib, not less than 5 feet apart, at least 100 feet back from the working face and out of the line of blast, or in a substantial, closed box at least 50 feet from the working face and out of the line of blast. Not more than 1 day's supply should be stored in these locations.

5.32. If underground operation boxes or magazines are provided, they should be:

- a. Placed in a crosscut or abandoned room neck at least 25 feet from roadways and trolley or power wires, and in a comparative-ly dry place.

- b. Kept locked at all times, except when in use.
- c. Protected from falls of roof.
- d. Constructed substantially and, if of metal, with electrically nonconducting lining.

5.33. When operation boxes or magazines are used, the explosives and detonators should be kept preferably in separate boxes or magazines. If kept in the same box, they should be separated by at least a 4-inch, substantially fastened hardwood partition, or the equivalent.

5.34 No more than a 36-hour supply of explosives or detonators, including any surplus remaining from the previous day, should be stored underground in an operation box or magazine. To avoid deterioration of explosives, older explosives should be used first.

Blasting Practices

5.35. All explosives used in underground coal mines should be of permissible type. Permissible explosives should be used as follows:

- a. Fired only with instantaneous electric detonators of proper strength.
- b. Fired with permissible shot-firing units.

NOTE: In view of the fact that various permissible multiple shot-firing units are not obtainable because of war conditions, continued use of nonpermissible multiple shot-firing units is necessary, and companies using nonpermissible multiple shot-firing units should take extraordinary precautions to minimize the hazard of gas ignition by arcs during breakage of blasting wires or contact of wires. These precautions ordinarily include good ventilation, careful testing for gas before blasting, and rock dusting near faces being shot.

- c. Not fired on the solid unless it is impossible to cut the coal.
- d. To prevent blow-throughs, all portions of the borehole should have a burden of at least 18 inches of solid coal.
- e. Stemmed with at least 24 inches of incombustible material, or one-half the length of the hole should be filled with stemming if the hole is less than 4 feet in depth.
- f. The region in which blasting is done should be well-protected by rock dust, as provided in standard 7.06, unless floor, ribs, and roof are naturally wet.

- g. Shots should not be fired in any place where methane can be detected with a flame safety lamp or more than 1 percent can be detected by an electric methane detector.
- h. Examination for gas should be made immediately before blasting, and after blasting before any work is resumed. However, if the mine is not classed as gassy, examination need not be made if the quantity of explosive used per hole is 1-1/2 pounds or less.
- i. Charges exceeding 1-1/2 pounds, but not to exceed 3 pounds, should be used only if:
 - (1) Boreholes are 6 feet or more long.
 - (2) Explosives are charged in a continuous train with no cartridges deliberately deformed or crushed, with all cartridges in contact with each other, and with the end cartridges touching the rear of the hole and the stemming, respectively.
 - (3) Class A or Class B explosives are used.

NOTE: Class A or Class B explosives produce only small or medium quantities of toxic gases. As of April 1945, the only permissible explosives not in this class are Liberty No. 1 and Columbia No. 2.

5.36. Shots should be fired by certified shot firers or other certified officials. In the absence of State certification, the company should designate certain competent persons to fire shots.

5.37. Boreholes in coal should be drilled at least 6 inches less than the depth of the cut.

5.38. Before being charged, the boreholes should be cleaned and checked to see that they are placed properly and of correct depth in relation to the cut.

5.39. Improperly placed boreholes or holes having insufficient or excessive burden should not be charged.

5.40. The cut or shear should be reasonably free of machine cuttings and excess water before shooting.

5.41. Electric power should be cut off equipment at or near a face before explosives are taken to such face, during charging, and between charging and firing of shots.

5.42. Each primer should be made up at or near the face immediately before loading and in a place removed from tracks, trolley wires, power

lines, trailing cables, pipe lines, steel ropes, and conveyor pans. The primer should be placed in the hole in such a manner that the detonator points toward the bulk of the charge.

5.43. Only wooden tamping bars should be used.

5.44. Leg wires of electric detonators should be kept shunted or the ends twisted together until ready to connect to the firing cable.

5.45. Blasting cables should be:

- a. Well-insulated, at least 100 feet long, and as much longer as may be necessary to assure the safety of the shot firer.
- b. Kept shunted or short-circuited at the battery end until ready to attach to the blasting unit.
- c. Staggered as to length at the detonator end, or well-separated, to prevent short-circuiting.
- d. Wound up after each shot or adequately supported on timbers or rib. In lieu of blasting cables, blasting circuits supported on insulators, extending from a safe place for the shot firer to near the face, may be used in each working place.
- e. Free of worn places; these should be properly insulated as soon as observed.
- f. Kept away from track, power wires, pipe lines, and other possible sources of active or stray currents.

5.46. Roof and face of working places should be tested before blasting; the roof should be tested and the place examined for fire after blasting.

5.47. Shots should not be fired from the power or signal circuit while any men are in the mine.

5.48. Only permissible shot-firing units, except as specified in standard 5.35b, should be used unless blasting is being done from the surface when all men are out of the mine.

5.49. Adobe (mudcap) or other open, unconfined shots should not be fired in any bituminous or lignite mine.

5.50. Ample warning should be given before shots are fired; this also applies to Cardox and Airdox blasting.

5.51. To prevent dependent shots, the boreholes of each working place should be loaded and fired one at a time unless they are all fired simultaneously or fired simultaneously in benches.

NOTE: A dependent shot is one, the firing of which may be made unsafe by the firing of one or more preceding shots, or the safety of which is or may be affected by the firing of one or more preceding shots.

5.52. The simultaneous firing of several shots with men in the mine should be governed by the precautions set forth in standard 5.35.

5.53. Delay electric detonators should not be used unless all persons other than shot firers are out of the mine at the time of blasting.

However, if delay electric detonators are used with the shift in the mine, or with shot firers only in the mine, extraordinary precautions should be taken to minimize the hazard of gas or dust ignition. These precautions ordinarily include good ventilation, careful testing for gas before blasting, thorough rock dusting near faces being shot, and thorough wetting of the face region where feasible.

NOTE: The use of delay electric detonators involves a quick succession of blasts, any one of which, after the first shot, may ignite coal dust raised by, or gas released by, a previous shot.

5.54. A waiting period of at least 15 minutes should elapse before anyone returns to the face when a misfire occurs in electric blasting. After such failure, the blasting cable should be disconnected from the source of power and the battery ends short-circuited before electrical connections are examined. This also applies to Cardox blasting.

5.55. If the circuit outside of a borehole is not the source of failure, handling of the misfire should be supervised by a certified foreman or other competent person. This applies to blasting both with explosives and Cardox.

5.56. Explosives should be removed by firing a separate charge at least 2 feet away from and parallel with the misfired charge, or by carefully washing any stemming from the borehole with water and inserting the new primer. Careful search should be directed toward recovery of any undetonated charge.

5.57. An accurate record should be kept of:

- a. The amount of explosives and detonators issued, used, and returned.
- b. The number of misfired shots.
- c. The number of blown-out shots.
- d. Any holes the shot firer refuses to charge or fire.
- e. The total number of shots fired, misfired, blown out, or burned out.

Cardox

5.58. Charged Cardox shells should be transported underground in insulated cars or in insulated boxes placed in ordinary mine cars.

5.59. Charged Cardox shells should be stored on wooden racks in a crosscut or abandoned room neck at least 10 feet from power lines and haulage tracks.

5.60. A well-insulated wire should be used for the connection to the insulated or "hot" terminal of a Cardox shell. A new piece of wire should be used for the connection of each blast; the wire may be used a second time for the grounded connection of the shell.

5.61. Cardox shells should be wired at the working face only and away from the track, other electric equipment, or drill truck.

5.62. The ground wire of a Cardox shell should be attached first; the wires should be short-circuited before the "hot" wire is attached and should not be untwisted until it is time to attach the shooting cable.

5.63. All protruding wires should be removed from all shells, whether charged, discharged, or misfired, before they are removed from the face.

5.64. Cardox should not be shot off the solid, over heavy rock binders or shale, or in a "tight" shot.

5.65. Everyone should be 100 feet or more from a Cardox shot and have, if possible, two or more intervening right angles between him and the shot.

5.66. "Sprag pipes" or other devices or methods should be used to prevent flying shells.

5.67. A Cardox misfire caused by the failure of the disk to rupture frequently involves a heated shell with likelihood of its bursting. Such misfires should be handled under the supervision of a foreman or other competent person. When misfires occur, shells should be marked conspicuously upon removal from the hole, and they should be either bled off or treated as charged shells.

Airdox

5.68. The following recommendations apply to the use of Airdox:

- a. Fireproof housing and ventilating requirements for underground Airdox compressor stations should conform to recommendations in these standards (standards 9.41, 11.08).
- b. The compressor motor should be protected with compensating starting and overload relays.

- c. Compressed air should be conducted from the compressor to within practical working distance of the face by steel tubing tested to a pressure of 20,000 pounds per square inch.
- d. As far as practicable, steel air tubing should not be installed in haulage or other regularly traveled entries.
- e. All air lines should be grounded at the compressor.
- f. Suitable unions should be installed on all lines of steel tubing at not more than 400-foot intervals.
- g. A cut-off valve should be installed in all branch lines close to the main air line and also at the inby end of all steel air lines.
- h. Steel or copper air lines should not be handled or repaired while air pressure is in the line.
- i. Copper air lines should be equipped with shut-off valves.
- j. Shooting or release valves should not be less than 45 feet from the face and should be around at least one corner at an angle of 90° with the center line of the place in which coal is being broken down.
- k. After the breaking down of coal in any one place has been completed, the shell should be disconnected immediately from the air line.
- l. When the release valve is opened to discharge the shell, it should remain open until time to charge the shell in the next borehole.
- m. Dust in drill holes should be washed out.
- n. When coal is shot, holes should not be drilled on the solid or in the roof. The shell should be pushed to the back of the drill hole, then withdrawn far enough to form an air cushion.
- o. When the pillar between working places is less than 10 feet in thickness, all men should be removed a safe distance from such adjoining working place before Airdox is released.
- p. Steel or copper air tubing should be suitably insulated where it is across trolley or other electric wires or under the track.
- q. All pressure tanks and lines should be blown out at least once a week or more often, if necessary, to prevent accumulations of oil or moisture.

- r. Air tubing should be examined periodically for kinks or other weaknesses and replaced when any defects are found.
- s. The part of the tubing that is affected by frequent coiling and uncoiling should be renewed periodically because of the dangers from kinking and crystallization.
- t. The tubing should be properly coiled and uncoiled.

6. VENTILATION AND MINE GASES

Main Fans

6.01. Main fans should be:

- a. Installed on the surface.
- b. In a fireproof housing. If present installations do not meet this recommendation, such installations should be made fire-resistant.
- c. Provided with fireproof air ducts. If present ducts do not meet this recommendation, they should be made fire-resistant.
- d. Offset from nearest side of mine opening. If a new fan is installed or the present fan is moved, the offset distance should be at least 25 feet.
- e. Provided with ample pressure relief or explosion doors.

NOTE: In lieu of provisions d and e, the fan may be directly in front of or over a mine opening provided the opening is not in direct line with possible forces coming out of the mine if an explosion occurs, and provided further that there is another opening having a weak-wall stopping or explosion doors that would be in direct line with the forces coming out of the mine if an explosion occurs, such opening to be not less than 25 nor more than 100 feet from the fan opening.

- f. Installed to permit reversal of air flow.
- g. Operated continuously, except when the mine is shut down with all men out of the mine. In such event, after the fan has started, the mine should be examined for gas and other hazards and made safe before men, other than examiners, are permitted in the mine.
- h. Provided with a pressure-recording gage or water gage.
- i. Provided with an automatic device to give the alarm when the fan slows down or stops unless the fan is constantly attended.

j. Inspected daily and a record kept of the inspection.

k. On a circuit independent of the mine circuit.

6.02. Ventilating fans should be so located that the return air from the mine cannot be drawn into the intake openings.

6.03. If the main fan of a gassy mine fails or stops for 5 minutes or more, measures should be taken immediately to withdraw the men from the mine. After the fan has been started, the mine should be examined thoroughly for gas and made safe for operation before the men reenter. The same procedure should be followed in a section of a gassy mine if it depends upon a booster fan.

6.04. If the main fan of a nongassy mine fails or is stopped more than 30 minutes, the men should be withdrawn from the mine. Before the men reenter the mine after the fan has been started, the mine should be examined thoroughly for gas and made safe for operation.

6.05. If stoppage of a main fan of a gassy mine is more than momentary, electric power should be cut off from face sections, and if stoppage is as much as 5 minutes, power should be cut off from the entire mine. A thorough examination for gas should be made before power is restored.

6.06. The area around fans should be kept free of dry grass, brush, and rubbish for at least 100 feet in all directions.

6.07. A second source of power, such as an internal-combustion or steam engine, should be provided at a gassy mine to operate the main fan in case of power failure. For a very gassy mine a separate standby fan installation should be provided and maintained in good condition.

Booster and Auxiliary Fans

6.08. A booster fan should be used only for ventilating a distant extension of a mine that is impracticable to ventilate by improvement of airways and if the construction of a new ventilation opening is not feasible. If installed for such reason, the fan motor should be of enclosed type, the surroundings of the fan fireproofed, and the fan so installed and so located with respect to workings as to prevent recirculation of air. Passage by a fan installation should be by means of an air lock, the doors of which should each have at least 30 square feet cross-sectional area and open automatically when the fan stops operating. Under these conditions, sections 6.03, 6.04, and 6.05 apply.

6.09. A booster fan should be on a power circuit independent of the mine and ^{be} equipped with an automatic relay to cut off current from that portion of the mine ventilated by the booster fan, if the fan stops.

6.10. Auxiliary fans or blowers with tubing should not be used in coal mines, except to ventilate the faces of rock tunnels being driven between two

coal beds or through faults and wants. However, if so used in rock tunnels, they should be powered with permissible driving units, operated continuously, inspected at least twice during each 8-hour period, and so placed that recirculation of air is impossible.

Volume of Air

6.11. The quantity of air reaching the last open crosscut in any pair or set of working entries should be at least 6,000 cubic feet a minute; however, when mines are worked within short distances of portals, this quantity may be varied within strict limits of safety.

6.12. Each working place should be ventilated by a perceptible air current sufficient in quantity to dilute and carry away any flammable or harmful gases.

6.13. A split ventilating system utilizing air crossings should be used.

6.14. Airways should be adequate in size and number and kept clear to permit free passage of air; this includes nonhaulage air courses as well as those utilized for haulage or man-travel.

Coursing of Air

6.15. Air should be measured by the mine foreman, his assistants, or other certified official at least once each week at or near the mouth of the main intake and return of the mine and also in or immediately adjacent to the last crosscut in each air split. Tests should be made with a permissible flame safety lamp or other methane indicator in such splits and in the main return. A record of these measurements and tests should be kept in a book furnished for this purpose.

6.16. The main-intake and main-return air currents in mines should be in separate shafts, slopes, or drifts; however, this does not preclude the use of substantial, fireproofed curtain walls in auxiliary shafts.

6.17. Haulage and hoisting openings and main and intermediate (between main and gathering haulage) haulageways should be in intake air. It is recognized, particularly in view of war conditions, that changes in ventilation to comply with this standard may be of such magnitude that it would be impracticable to carry them out at present; however, such changes should be made as soon as feasible.

6.18. Ventilation should not be diverted from idle sections to active sections to provide an adequate quantity of air for different working shifts.

6.19. Changes in ventilation which may affect the safety of the men should be made when the mine is idle and with no men in the mine other than those engaged in changing the ventilation.

Crosscuts and Stoppings

6.20. Crosscuts should be made at intervals sufficient to assure adequate ventilation at faces. Ventilation needs are defined further in standards 6.11 and 6.39.

6.21. Room crosscuts should be closed where necessary to obtain a perceptible movement of air at the face.

6.22. Not more than one crosscut should be left open between the faces of entries and the first outby temporary or permanent stopping.

6.23. Rooms or chutes should not be worked off an entry heading ahead of the last crosscut, even if line brattices are utilized. This does not apply to the driving of such places to make a connection at the first crosscut or similar passageway used as a main airway in connection with an entry. It does apply to extending such places beyond the airway before the main intake and return passageways are connected.

6.24. Stoppings between intake and return of all main haulageways should be as airtight as possible and constructed of substantial, incombustible material, except that one temporary stopping of wood or brattice cloth may be erected between the last permanent stopping and the last crosscut. However, in heavy or caving ground timber laid longitudinally skin to skin may be used.

6.25. On branch haulageways, stoppings should be as airtight as possible and constructed of incombustible or fire-resistant material with the exception stated in the preceding standard.

6.26. Stoppings should be completed promptly as passageways are advanced.

6.27. Man-doors placed in stoppings should be so hinged or constructed as to be self-closing, tight, and open against the air current. Preferably, their dimensions should be at least 30 by 30 inches.

Doors and Overcasts

6.28. Where doors are used in connection with coursing the air in any one split or in lieu of a split ventilation system, they should be:

- a. Installed in pairs to form air locks; where this is not feasible, tight check curtains, well-maintained, should be hung in connection with single doors. Air locks should be ventilated sufficiently to insure against the accumulation of gas within the enclosed area.
- b. Self-closing.

- c. Kept closed except when men, equipment, or trips are passing through them.
- d. Equipped with substantial handles and with small windows for observation purposes.
- e. Hung so as to open against the ventilating current.

6.29. Where doors affording access to fans or main air courses are difficult to open because of high ventilating pressure, they should be installed in pairs to form air locks.

6.30. Overcasts should be tightly constructed of incombustible material and of ample area to pass the required quantity of air.

Line Brattice

6.31. Line brattice should be:

- a. Used to conduct the air from the last open crosscut to working faces when necessary to remove gases, explosives fumes, smoke, and dust.
- b. Constructed with boards at top and bottom or otherwise secured to provide adequate face ventilation.
- c. Of fire-resisting material.

6.32. The space between the rib and the line brattice should be large enough to permit free flow of air, and this space should be kept clean and unobstructed.

Old Workings

6.33. Open old workings and pillar sections (gob areas) in gassy mines should have connecting openings for bleeding or draining gas into a return.

6.34. All entries, rooms, panels, or sections that cannot be kept well-ventilated throughout and regularly inspected, or that are not being used for coursing the air, travel, haulage, or the extraction of coal, should be sealed by substantial fireproof stoppings.

6.35. In every sealed area one or more stoppings should be fitted with a pipe and valve to allow the air behind the seals to be sampled and also to provide a means of determining any existing hydrostatic pressure.

6.36. Air that has been used to ventilate pillar lines should not be used to ventilate other working places; moreover, air that has been used to ventilate caved areas or open abandoned sections should not be used to ventilate active workings.

Mine Gases

6.37. A mine should be classed as gassy when 0.10 percent or more methane can be found in any open workings by systematic search, or if the mine records establish the fact that methane has been found or ignited, provided that any classification of a mine as gassy by analyses of air samples should be based on two or more samples, each containing 0.10 percent or more methane.

If samples collected from behind seals contain more than 2 percent combustible gas, this fact should classify the mine as gassy.

6.38. If flammable gas can be detected in the air of a working place with a flame safety lamp, or if it contains more than 1 percent of flammable gas as determined by an electric methane detector or by chemical analysis, the ventilation should be improved immediately. If air in the working place contains more than 2 percent flammable gas (slightly less than a 1/2-inch cap on a testing or low flame of a flame safety lamp), the workers should be withdrawn until the ventilation is improved. By "air of a working place" is meant air not nearer than 1 foot from the face. Tests of air for gas should be made at such points as conditions may warrant.

6.39. If the air immediately returning from a split that ventilates any group of active workings contains more than 0.5 percent of flammable gas, as determined by chemical analyses in duplicate or by other recognized means of accurate detection, the ventilation should be improved immediately if at all possible. If this air contains more than 1.5 percent of flammable gas, the workers should be withdrawn until ventilation has been improved.

6.40. The ventilation should be improved if the air in working places or travelingways contains less than 20 percent oxygen or more than 0.5 percent carbon dioxide or any poisonous gases as determined by chemical analysis.

Examinations for Gas

6.41. At least two permissible flame safety lamps should be kept in proper working condition at every coal mine, and at least two persons should be kept well-informed as to the safe maintenance and use of flame safety lamps.

6.42. Only permissible methane detectors and air sampling and analyses should be used for determining methane. (Permissible flame safety lamps are considered a type of permissible methane detector.)

6.43. All men required to use methane detectors should be instructed thoroughly in their use and limitations.

6.44 Fire bosses and others who are required to test for gas should wear corrective-lens glasses if necessary for good vision.

6.45. Enough fire bosses should be employed in gassy mines; they should:

- a. Begin examination of the mine not more than 3 hours before each shift enters the mine; however, in multiple-shift operations, such examinations may be made within 3 hours of the next shift by qualified officials of the shift on duty.
- b. Examine every working place, every place adjacent to live workings, every roadway and travelway, every unfenced road to abandoned workings, and all accessible falls in the mine for explosive gas and other hazards.
- c. Mark their initials and the date at or near the face of each place examined.
- d. Place a danger sign across each entrance to every place where a dangerous condition is found. The danger sign should be removed only by a certified official after the danger has been removed.
- e. Report to a proper official on the surface, or at designated underground stations, any dangers found before the men enter the mine or pass such designated stations.
- f. Record in ink the result of their inspection, in a book kept on the surface for that purpose. Similar records also should be kept at designated underground stations.

6.46. The mine foreman or his designated assistant on each shift should read and countersign the fire boss' reports of examination preliminary to that shift before the men enter the mine or pass designated underground stations. The mine foreman should read and countersign the assistant foreman's and fire boss' reports daily.

6.47. Pillar workings should be examined for explosive gas and other dangers before a cave is made. If gas is found in amounts that can be detected with a permissible flame safety lamp, the cave should not be made until gas is removed; if removal of gas is not feasible, other precautions should be taken to safeguard all employees.

6.48. Accumulations of gas should be removed under the direct supervision of a foreman or other competent official, and no men should be permitted to work, or electric equipment be operated, on the return of the split while gas is being removed.

6.49. All working places in gassy mines should be inspected for gas during the shift by a certified official.

6.50. All coal mines other than gassy mines should be inspected carefully for methane at least weekly.

7. CONTROL OF COAL DUST

Sources and Accumulations of Coal Dust

7.01. Coal dust should not be permitted to accumulate on roadways, along conveyor lines, and on gob, rib, roof, or timbers.

7.02. Machine cuttings from coal beds, unless the dust therein contains more than 65 percent incombustible, should be loaded and hauled out of the mine if at all practicable. If removal from mine is not practicable, cuttings should be placed back from the face and covered with a layer of one-half inch or more of rock dust.

7.03. Mine cars should be maintained as dusttight as possible.

7.04. Coal should be so loaded that spillage during transportation will be minimized.

Allaying Coal Dust and Rock Dusting

7.05. To allay coal dust, water or wetting solutions should be used on loading machines, on the cutter bars of mining machines, and at other evident sources of dust.

7.06. All bituminous-coal mines (lignite mines excepted) should be kept thoroughly rock-dusted in all open, unsealed places to within 40 feet of the face; however, if the top, floor, and sides of the mine as a whole, or any part of the mine, are wet, rock dusting is not required in such mines or wet sections thereof. If there is any indication that the mine, or any part of it, is becoming dry, the mine or portion of the mine so affected should be rock-dusted.

7.07. Before rock dust is applied, all accumulations of fine coal should, as far as possible, be removed from the sections of the mine to be rock-dusted.

7.08. Where rock dust is applied, it should be distributed upon the top, floor, and sides of all open, unsealed places and maintained in such quantity that the incombustible content will not be less than 65 percent. In trackless entries and air courses, protection in lieu of generalized rock dusting may be had by using bags filled with rock dust if they are placed at regular intervals and staggered as described in Bureau of Mines Report of Investigations 3411. The frequency of placement should be such that there is in the bags 10 pounds of rock dust per linear foot of entry; the weight of dust per bag should not exceed 50 pounds.

7.09. When methane is present in the ventilating current, the 65-percent minimum percentage of incombustible should be increased 1 percent

for each 0.1 percent of methane.

7.10. Sampling should be done frequently enough to determine whether additional rock dust is required.

7.11. A record should be kept showing the location of the places of sampling, the results of the tests made, and the quantity of rock dust applied monthly as well as annually.

8. HAULAGE

Railroads

8.01. There should be an unobstructed space of 24 inches from the widest part of railroad cars or locomotives to the nearest obstruction on both sides of each railroad track. Where clearance is less than 24 inches, a warning sign calling attention to this condition should be posted.

8.02. All switch throws on the surface should be so installed as to provide adequate clearance for switchmen.

8.03. Derail devices should be installed where necessary on railroad sidetracks near junctions with main lines.

8.04. In handling railroad cars, a brakeman should:

- a. Use a suitable brake stick.
- b. Use a railroad-type pinch bar for shifting cars.
- c. Wear a protective hat.
- d. Wear snug-fitting clothing.

Surface Crossings

8.05. Hazardous crossings on the surface should be guarded while cars are being moved.

8.06. Where surface operations require that many persons pass over the haulageway (railroad or mine surface), a warning signal should be installed or an overhead walkway or underpass provided.

8.07. All railroad and mine-surface track crossings should be provided with warning signs.

Surface Inclines

8.08. Outside planes or inclines should have:

- a. A positive stopblock at the top.

- b. A derail near the top.
- c. A derail near the bottom.

8.09. When men are transported in cars on outside planes or inclines:

- a. The cars should be provided with level seats and handholds.
- b. Tools or other material should not be carried in the same cars.

Haulage Roads

8.10. Haulage roads should be kept free of coal spillage and debris.

8.11. Roadbed should be kept well drained and surfaced.

8.12. Rails should be heavy enough to carry safely the heaviest rolling stock and should be attached firmly to ties of adequate size and spacing.

8.13. On all haulage roads, rail joints should be connected with plates or welded.

NOTE: May not be applicable in rooms where animal haulage is used and equipment is light.

8.14. The track should be alined properly and free from high or low joints, broken rails, defective switches, defective frogs, and improperly alined frogs.

8.15. Frogs, guard rails, and lead rails should be blocked if there is danger of persons catching their feet in them.

8.16. Track switches should be provided, complete with frogs, throws, bridle bars, and guard rails.

NOTE: May not be applicable in rooms where animal haulage is used or where cars are handled manually.

8.17. The rod extending from the bridle bar to the throw should be so installed as to minimize the stumbling hazard.

8.18. Switch stands should be placed on the clearance side, preferably in shelter holes.

8.19. Switches on main and cross or face entries should be illuminated with electric lights; however, these lights should not be installed within 150 feet of any open active or abandoned workings or within 150 feet of any gob area or in any air containing more than 0.5 percent methane.

Clearance and Shelter Holes

8.20. There should be a clearance of 30 inches or more on at least one side of surface mine tracks, but if it is not practicable to obtain such clearance at some places, these places should be marked with signs warning of restricted clearance.

8.21. Where practicable, there should be a continuous clearance (on the side opposite the trolley wire if such wire is used) from the mine portals to all working faces, of at least 30 inches from the nearest obstruction to the farthest projection of moving equipment, such as locomotives, cars, and conveyors of all types.

8.22. On the other or trolley-wire side there should be a clearance of at least 12 inches from the nearest obstruction to the farthest projection of moving equipment.

8.23. Where it is necessary for men to cross conveyors and the width of conveyors or low roof introduces a hazard, suitable cross-over bridges should be provided. In low coal, roof should be brushed to the height necessary to provide a safe crossing.

8.24. A safety zone should be provided at all points where supplies are unloaded from conveyors.

8.25. For safe travel of men, transportation of material, and exit from workings if a fire or explosion occurs, in coal less than 5 feet in thickness, at least one entry of each set of entries should be brushed to a height of 5 feet or more. This entry should be provided with track unless shuttle-car transportation is used.

8.26. Clearance should not be obstructed by loose rock or coal, supplies, or other materials.

8.27. At sidetracks there should be a clearance of at least 30 inches between the farthest projection of equipment on any two tracks.

8.28. Shelter holes should be:

- a. Provided along all haulageways where locomotive, rope, animal, or shuttle-car haulage is used.
- b. On the clearance side.
- c. Not more than 60 feet apart.
- d. Not more than 4 feet wide and not less than 5 feet deep, and 6 feet in height or as high as the traveling space if it is less than 6 feet. Room necks and crosscuts complying with the above standards should be considered as shelter holes, even though wider than 4 feet.

e. Provided at all switch stands except room switches.

f. Provided at all doors.

g. Kept clean and free of obstruction.

8.29. A shelter hole at least 10 feet deep, 4 feet wide, and 6 feet high should be provided at the bottom landing of a slope where cars are handled.

Haulage Equipment

8.30. Short pieces of rail, ties, or props should not be used to raise or slue derailed cars and locomotives.

8.31. Locomotives should be equipped with suitable rerailers, jacks, chains, and other necessary tools for rerailing cars or locomotives.

8.32. Effective shields should be installed in the decks or cabs of locomotives to protect the feet of the operator.

8.33. Trolley locomotives should be provided with an insulating seat and an insulating deck (cab) floor mat.

8.34. Nonpermissible internal-combustion engines should not be used underground.

8.35. Steam locomotives should not be used underground.

8.36. Where two or more locomotives or other self-propelled, track-mounted equipment is operated independently on the same track, a block- or telephone-signal system should be used to control its movement.

8.37. Self-propelled, track-mounted equipment, including locomotives, cutting machines, and loaders, should be handled carefully and kept under control at all times. Such equipment should be provided with efficient headlights and warning devices. When this equipment is moved into or out of a working place, it should be stopped at any intersection or curve and be preceded by a helper or flagman.

8.38. Room hoists and other small hoists (not used in transporting men) should be:

a. Securely mounted and, if necessary, braced against the roof.

b. Installed so as not to obstruct the clearance space.

c. Provided with a drum flange high enough to prevent the rope from slipping off the drum.

d. Equipped with brakes adequate for the required service.

e. Provided with a well-maintained rope of adequate size securely fastened to the drum and to the clevis.

8.39. Haulage equipment should be maintained in safe condition.

Safety Devices and Practices

8.40. Sprags, chains, or car blocks should be used on all standing cars, regardless of grade. If cars have **brakes** they also should be set. The use of chips or small pieces of coal or rock or similar makeshifts should not be considered adequate blocking.

8.41. Man-trips or man-cars on grades exceeding 3 percent should be provided with mechanical devices, or other measures should be taken designed to stop the car or trip if haulage equipment fails.

8.42. On all slopes and planes having a knuckle, there should be a positive-action stopblock at or above the knuckle, and a derail.

8.43. On entries going to the rise, a positive stopblock or derail should be placed below the switch of the first active working place.

8.44. On entries going to the dip, a positive stopblock or derail should be placed just above the switch to the first active working place, and a stopblock should be placed just below the switch to the last active working place.

8.45. When coal is not being loaded in a room or entry face, and nevertheless, men are working therein, a positive stopblock or derail should be placed across the room or entry track or room switch kept closed to prevent cars from being inadvertently pushed or running into place.

8.46. Slides or skids should be used on descending grades where the locomotive is not adequate to control the trip.

8.47. A permissible trip light should be used on the rear of all pulled trips and on the front end of trips being pushed or being lowered on slopes. (It may be desirable to have lights on each end of ascending trips on slopes.) Reflector buttons should not be substituted for trip lights.

8.48. Pushing of cars should be eliminated insofar as possible; trips should not be pushed on main haulageways except at partings or in an emergency.

8.49. Only authorized persons should operate locomotives.

8.50. Riding on locomotives should be prohibited except to those operating the trip and persons authorized by management.

8.51. Riding on top of loaded cars or between cars should be prohibited. If practicable, men should not ride on front bumpers of cars.

8.52. Motormen or brakemen should not get on or off cars or trips in motion.

8.53. Brakemen should use whistles for signaling.

8.54. When a motorman leaves a locomotive, even temporarily, the controller should be set at neutral, the brake set tightly, and the trolley connection removed from the wire.

NOTE: If a locomotive is left on a through track, a warning light should be provided.

8.55. Back-poling should be allowed only at places where the trolley pole cannot be reversed, or when going up extremely steep grades, and then only at very slow speed.

8.56. "Nipping" should not be permitted.

8.57. Flying switches should be prohibited.

8.58. At least two cars should be placed between the locomotive and cars or trucks carrying rails, pipes, timbers, or other long material.

8.59. Where belt haulage is used, provision should be made for the installation of track haulage on a parallel entry or the same entry for the transportation of men in an emergency. If shuttle cars are available for this purpose no track installation is necessary.

8.60. An interval of at least 500 feet should be maintained between "light" locomotives traveling in the same direction; the locomotives should be operated at a slow speed.

8.61. Cars should not be coupled or uncoupled by hand while they are in motion unless a coupling hook or equally effective device is used.

8.62. Cars should not be coupled or uncoupled by hand from the inside of curves.

8.63. Locomotives approaching doors should be operated at slow speed, and warning should be sounded when approaching doors, curves, or where vision is obstructed.

8.64. Cars and trips should not be left standing in a place where they will endanger other trips or persons.

8.65. Cars and trips should not be left standing where they materially obstruct the ventilating current.

Transportation of Men

- 8.66. An official should be in charge of and accompany each man-trip.
- 8.67. Man-trips should be operated at a safe speed.
- 8.68. Man-trips should not be operated behind loaded trips on ascending grades or in front of loaded trips on descending grades.
- 8.69. Enough cars should be provided on man-trips to permit all men to ride inside and prevent crowding.
- 8.70. Men on man-trips should not ride in the car next to a trolley locomotive unless such car is specially designed to afford front-end and overhead protection.
- 8.71. When riding in a car on a trolley haulage road, men should ride on the side of the car opposite the trolley wire unless suitably covered man-cars are used.
- 8.72. Persons other than the brakeman should not be permitted to ride on the rear bumper of a man-trip, and no person should be allowed to ride between cars.
- 8.73. The man-trip should come to a full stop before men load and unload, and men should proceed in an orderly manner to and from man-trips.
- 8.74. A suitable place with seats should be provided at junction points where men may congregate while waiting for a man-trip or man-cage; it should be where lives of persons waiting would not be jeopardized by a run-away car or trip or the wrecking of car or trip.
- 8.75. Only tools and supplies that can be carried entirely inside a separate car or cars should be hauled on man-trips.
- 8.76. The trolley wire at man-trip stations should be adequately guarded; if practicable, the power should also be cut off while men are loading and unloading.
- 8.77. In general, it is not desirable to transport men on belts in low coal, but if men are transported on belts:
- a. There should be a minimum clearance of 24 inches between top side of belt and roof or cross bars, projecting cap pieces, overhead cables, wiring, and the like. There should not be less than 30 inches of side clearance on the wide side and 12 inches of clearance on the tight side of belts.
 - b. There should be an attendant at loading and unloading points, and there should be stop and start controls at these points.

Loading and unloading points or stations should be at least 50 feet from the loading heads and discharge ends of belts; they should be constructed to afford adequate man-clearance, including 5 or more feet of side clearance at man-loading stations.

- c. The belt should be stopped where men load and unload.
- d. The belt speed should be such as to afford proper safety to the men.

NOTE: 250 feet per minute is considered a reasonable speed if there is 24 inches or more of clearance.

- e. Men should ride at least 5 feet apart.
- f. Where belts are more than 1,000 feet in length or where they extend through stoppings, signal lines should be placed along the belt so that signals may be given from any point along the belt.
- g. Persons should not be transported past equipment protruding over belts unless clearance of such equipment is as specified in (a).
- h. Officials should supervise loading and unloading of belt man-trips.
- i. There should be electric lights along belt lines at 150-foot intervals, subject to restriction in standards 8.19, 9.21, and 9.72.
- j. The belts should not be on an excessive grade.

9. ELECTRICITY

Surface Transmission Lines

9.01. Overhead high-potential power lines should be placed at least 15 feet above the ground and 20 feet above driveways and should be supported and guarded adequately to prevent contact with other circuits.

9.02. Guy wires from poles supporting high-potential transmission lines should be grounded, unless equipped with insulators. If insulators are used, they should be installed near the poles.

9.03. The surface electrical equipment and overhead power circuits should be protected adequately against lightning or voltage surge.

9.04. High-potential power lines should be protected adequately by circuit breakers.

Transformer Stations

9.05. Unless surface transformers are isolated by elevation (8 feet or more above the ground), they should be surrounded by a suitable enclosure. If the enclosure is of metal it should be effectively grounded.

9.06. The gate or door to the transformer enclosure should be kept locked at all times unless authorized persons are present.

9.07. If surface transformers containing flammable oil are installed where they present a fire hazard (near mine openings and in or near combustible buildings), means should be provided to drain or confine the oil in event of rupture of the transformer casing.

9.08. Permanent underground stations containing transformers should be provided with doors that close automatically in case of fire; when practicable, these stations should be on separate air splits leading to the return. Stations containing transformers filled with flammable oil should be provided with door sills, or their equivalent, that will confine the oil if leakage or explosion occurs.

9.09. Portable transformer stations should be in fireproof housings that are either fully enclosed or fitted with doors that close automatically in case of fire. They should be in well-ventilated places only.

9.10. Casings of all transformers should be grounded unless protected by isolation (freedom from contact hazard by position).

9.11. DANGER--HIGH VOLTAGE signs should be placed on all transformer enclosures, high-potential switchboards, and other high-potential installations.

Substations

9.12. Switchboards should:

- a. Have ample working space around and back of them, free of rubbish and stored material.
- b. Have an entrance at each end to permit authorized persons to inspect, adjust, or repair apparatus back of the switchboard.
- c. Be adequately lighted.
- d. Have control readily accessible for emergency shut-down.
- e. Have a disconnecting switch on incoming power circuits.
- f. Have the entrance to the rear guarded against unauthorized entrance.

9.13. Underground stations for motor generators and other conversion equipment should be in well-ventilated fireproof rooms.

Power Circuits

9.14. Trolley and feeder wires should be:

- a. Securely supported on insulated hangers; on straight runs where the trolley wire is 5 feet or more above the rail, the hangers should be not more than 30 feet apart, and where the wire is less than 5 feet above the rail, the hangers should be not more than 20 feet apart; on curves the hangers should be so spaced that the trolley wire at any one hanger may be entirely disconnected without exposing the locomotive operator.
- b. Kept taut and not permitted to touch the roof, rib, cross bars, or doorframes.
- c. Properly aligned and placed at least 6 inches outside the rail.
- d. Installed on the opposite side from the clearance side and shelter holes.
- e. Sectionalized by proper electric switches at intervals not to exceed 1,500 feet; electric switches should also be installed in all branch lines near their beginning.
- f. Provided with sectionalizing switches at points where loaded mine cars are stored on idle days.
- g. Adequately guarded where men are required to work or pass under the wire, unless the wire is 6-1/2 feet or more above the top of the rail; preferably trolley wire less than 6-1/2 feet above the rail should be guarded throughout.
- h. Adequately guarded and sectionalized at man-trip stations and guarded on both sides of doors.
- i. Securely anchored and properly insulated at the ends.

9.15. The electric circuits should be of ample capacity for the current carried.

9.16. Power wires (single-conductor), whether bare or insulated, should be supported on or by well-designed and installed insulators and should not touch combustible materials, roof, or ribs.

NOTE: See standard 9.17 for power cables.

9.17. High-potential power cables (600 volts or more) in shafts, boreholes, and underground passageways should be adequate for the service intended, installed in a permanent manner, and guarded from mechanical injury. The mechanical and electrical character of the cable insulation and outer covering should consider electric shock and fire hazards, deterioration from mine water and electrolysis, and means of suspending or otherwise supporting the cable.

9.18. Power wires other than trolley wires should be properly insulated when passing through doors and stoppings and where they cross other power circuits.

9.19. Power should be disconnected when repair work is being done on electric equipment and accessories such as trailing cable, feed wire, trolley wire, switches, junction boxes, and the like.

9.20. If track is used as a power conductor, both rails should be well-bonded at every joint and cross-bonded at least every 200 feet.

9.21. The ends of trolley or feed wires should not extend beyond the last open crosscut and should be kept at least 150 feet from pillar workings, advanced workings, or any open, partly caved, poorly ventilated places.

9.22. A slope used for the haulage of coal should be protected from the hazards of dust ignitions by burying or removing electric cables and wires other than signal wires.

9.23. Wiring in underground structures should be insulated and installed properly.

9.24. Electric wiring in all surface buildings should be so installed as to present minimum fire and contact hazards.

Grounding

9.25. All metallic coverings and armor of cables and conduit should be grounded and should be electrically continuous to afford a conductor path for the ground circuit.

9.26. All metallic frames, casings, and coverings of motors, generators, switchboards, and other electric equipment that can become "alive" through failure of insulation or by contact with energized parts should be grounded.

9.27. Underground metallic pipe lines or ground circuits paralleling haulage roads or conveyor lines should be electrically continuous throughout and should be effectively grounded at intervals not exceeding 500 feet.

9.28. Ground connections should be frequently tested to determine their continuity and occasionally to determine their resistance.

9.29. The metal frames of drills and other electric tools intended to be held in the hands should be effectively grounded.

Circuit Breakers and Accessories

9.30. Electric equipment should be protected against excessive overload by fuses or equivalent protective devices of the correct type and capacity.

9.31. Wires or other conducting materials should not be used as a substitute for properly designed fuses.

9.32. Underground electric equipment should be provided with switches of safe design, construction, and installation.

9.33. Officials, haulage crews, electricians, and other persons connected with electrical maintenance should be familiar with the location of cut-out switches.

9.34. All principal switches should be marked so that they may be found readily in an emergency.

9.35. Circuit breakers should be provided to protect all power circuits. If they are automatic, they should be set so that the circuits cannot be overloaded.

9.36. Switches and circuit breakers should be so installed that they are readily accessible and can be operated without danger of contact with moving or live parts.

9.37. Switches and starting boxes used to control electric circuits should be of safe design.

9.38. All electric appliances, machines, and conductors should be large enough for the required work.

9.39. Dry wooden platforms, rubber mats, or other electrically nonconducting material should be kept in place at all switchboards and stationary machinery where shock hazards exist.

9.40. Rheostats and electric heaters should be so installed as to prevent fire, electric shock, or burn-injury hazards.

Pump and Storage-Battery Stations

9.41. Underground electric stations for permanent installations of pumps, compressors, and motor generators and other conversion equipment should be in well-ventilated, fireproof rooms.

9.42. Portable pumps and other portable electrically driven equipment should be so located and installed as to constitute the minimum possible

fire or man-contact hazard. They should be used only in well-ventilated places.

9.45. Battery-charging stations should be well-ventilated. If practicable such stations should be in fireproof rooms and the air ventilating them conducted directly to return airways.

Telephone and Signaling System

9.44. Telephone service should be provided from the surface to the working sections and as near the working faces as practicable where the mine workings are 1,500 feet or more from the surface. When available, permissible telephones should be used underground.

9.45. Preferably, the telephone lines from the surface to the principal working sections should be buried or brought into the mine in boreholes near the various working sections to avoid hazard of destruction of lines if fires or explosions occur underground. Telephones should be so installed as to be protected from damage of normal mine operation.

NOTE: If a feasible method of two-way communication between surface and underground, other than telephone, is devised which is protected against interruption by fire or explosion, it will answer the purpose of this recommendation.

9.46. Exposed telephone lines should be installed on the opposite side from power or trolley wires where at all practicable.

9.47. Telephone wires crossing power or trolley wires should be adequately insulated.

9.48. Telephone circuits on the surface that are exposed to lightning should be protected by means of lightning arresters.

9.49. Bare signal wires that are readily accessible to persons should not carry over 30 volts. (This does not apply to block-signal systems.)

9.50. Signal wires should be supported on insulators, and they should be adequately guarded where they cross other power circuits.

9.51. A control or signal system should be provided at the face to govern conveyor operations.

NOTE: Some permissible conveyors have such controls; pull signal systems are also used.

9.52. If a transformer is used to reduce voltage for a signal system, the signal circuit should be protected against high voltage.

NOTE: Protection against high voltage can be obtained by the use of a protector block connected in the signal circuit and located near

the transformer. An electronic rectifying-tube device is used by some companies to minimize the hazard of imposing on the signal circuit a voltage higher than the normal operating voltage.

Electric Face Equipment

9.53. Electric drills or other electrically operated rotating tools, intended to be held in the hands, and, where feasible, post drills should have the electric switch so constructed as to break the circuit when the hands release the switch. Hand-held drills should not be operated at a potential higher than 250 volts. In addition, it is desirable that all drills be equipped with friction or safety clutches.

9.54. Electrically driven equipment that is operated inby the first open crosscut between entries or rooms or in air that has ventilated one or more working places in gassy mines should be permissible.

NOTE: It is recognized that under war conditions it may be difficult, if not impossible, to obtain permissible equipment. Where non-permissible equipment is used in gassy mines, all possible precautions should be taken.

9.55. If nonpermissible electric equipment is used in face regions (inby the first open crosscut or air that has ventilated one or more working places) of gassy mines, it should be operated only under the following conditions:

- a. Each working place should be carefully examined for methane by a certified official or other competent person immediately before the equipment is taken into or operated in a working place.
- b. The general air of the place should not contain more than 0.5 percent of methane as determined by analysis or other recognized means of detecting methane.

NOTE: By "air of place" is meant air not nearer than 1 foot from the face. Any indication of methane on a flame safety lamp should be regarded as more than 0.5 percent of methane.

- c. If more than 1 percent of methane can be found in holes in the roof of any working place by analysis or by a methane detector (flame safety lamp or electric detector) the equipment should not be taken into or operated in the working place until the pocket of gas has been removed by additional ventilation.
- d. When used in face regions, tests for methane should be made at least every 30 minutes by a certified official or other competent person.

9.56. The trolley wire in a gassy mine should be in intake air; where this is not feasible, the trolley wire at least should not be permitted in air known to contain over 0.5 percent of methane, or in air returning from pillar recovery work or old workings, where falls or atmospheric changes may cause gas to be liberated suddenly.

9.57. Electrically driven permissible equipment should not be taken into or operated in any place if methane can be found, by analysis or other recognized means of detecting methane, amounting to more than 1 percent in the general air of the place.

9.58. Electrically driven permissible equipment operating in face regions in a gassy mine should be stopped at least every 30 minutes and the place carefully examined for methane by a certified official or other competent person.

9.59. Permissible equipment should be maintained in a good state of repair and in permissible condition.

9.60. Explosion-tested cable-reel locomotives should be equipped with a two-conductor rather than a single-conductor cable.

Cables

9.61. Trailing cables used underground should be constructed of materials that will not burn readily or produce dangerous amounts of harmful gases. Cables having these qualities should be considered when replacements are made.

9.62. Cables for portable or semiportable underground electric equipment should be provided with suitable taps equipped with fuses, unless properly connected to permissible junction or distribution boxes.

9.63. In gassy mines, permissible junction or distribution boxes should be used for making multiple power connections in the working places.

9.64. Temporary cable splices should be made in a workmanlike manner, mechanically strong, and well-insulated. Preferably, when a cable is defective, a stand-by cable should be used and the defective cable sent to the shop for permanent splicing and vulcanizing.

9.65. Permanent cable splices should be made by competent persons in surface or underground repair shops.

9.66. Length of trailing cable should not exceed the minimum required for satisfactory operation of machines.

NOTE: To prevent heating of cables, they should be in long loops rather than placed in piles or coils. Where reels are not used, long lengths of trailing cable may be avoided by using short lengths

and splicing them together with splice boxes as the working place advances and taking them out of service as the place is retreating.

Illumination of Haulageways

9.67. Electric lights on the slope or shaft bottom should be on a separate circuit from the trolley circuit.

9.68 Lighting circuits should be provided with adequate fuses.

9.69. Lamp sockets with exposed metal parts should not be used underground.

9.70. Lighting wires should be supported by suitable insulators and securely fastened to the power conductors with clamps.

9.71. Electric lights should be so placed that they cannot come in contact with combustible material.

9.72. Electric light circuits should not be installed at or near any working face.

10. ADDITIONAL SAFEGUARDS FOR MECHANICAL EQUIPMENT

Face Equipment

10.01. Mining machines should not be loaded on their trucks or trammed unless they are equipped with adequate locking devices on the cutter chains and the end bits of the cutter bar guarded or removed.

10.02. To prevent injury from side slip of caterpillars from rail, the operator of caterpillar machine should ride, if practicable, on the step provided for that purpose when moving from place to place.

10.03. Machinemen, drillers, and loading-machine operators should not operate their equipment when any persons are in such proximity as to be endangered.

10.04. Rock drilling with percussion drills should be done wet. Men drilling rock with auger-type drills should either wear permissible-type respirators or use water, if dust is produced.

10.05. Adequate tools should be available in working places, and these should be maintained in good condition.

10.06. If axes are used underground, the over-all length of the ax and handle should not exceed 18 inches.

Shop Equipment

10.07. Machinery and belting exposed to possible personal contact should be guarded adequately, as indicated below:

- a. Gears, sprockets, friction devices, and couplings with protruding bolts or nuts should be completely guarded.
- b. Shafting and projecting shaft ends within 6 feet of floor or platform level should be completely guarded.
- c. Vertical or inclined belt, chain, or rope drives should be suitably guarded to a height of at least 7 feet from the floor.
- d. Horizontal belt, chain, or rope drives within 7 feet of floor or platform should be guarded.
- e. Fly wheels should be guarded. Where fly wheels extend more than 6 feet above the floor, they should be guarded to a height of at least 6 feet.
- f. Circular and band saws and planers should be adequately guarded.
- g. Locomotive pits should be properly guarded, and guard kept in place when the pit is not in use.
- h. When guards are removed for oiling or repairs they should be promptly replaced.

10.08. Shop machinery should be adequately illuminated.

10.09. Adequate clearance should be provided at machine installations, and passageways should be kept free of stumbling hazards.

10.10. Machinery should not be repaired or oiled while in motion, unless such oiling can be done without danger to the oiler.

10.11. A guard or safety device removed from any machine should be replaced before the machine is put in operation.

10.12. Mechanically operated grinding wheels should be equipped with:

- a. Safety washers.
- b. Substantial retaining hoods, the throat openings of which do not expose more than a 90° sector of any wheel. Preferably, not more than a 60° sector should be exposed.

10.13. If grinding operations are frequent or constant a dust-collecting system should be installed, or a permissible respirator should be worn by the operator.

10.14. Stationary welding locations should be well ventilated and shielded.

10.15. Hand tools should be kept in good condition. Tools with battered heads should be properly dressed or discarded.

11. UNDERGROUND FIRE PREVENTION AND CONTROL

Organization and Facilities

11.01. Procedures to be followed if a mine fire occurs should be adopted and if desirable an outline thereof posted. Mine officials should be familiar with approved methods and procedures for combating and controlling mine fires.

11.02. Fire-fighting equipment and fire prevention and control measures adequate for the size of the mine and number of men employed should be provided.

NOTE: Such measures may include:

- a. Rock-dust stations to be used for fire-fighting purposes, containing at least six bags of rock dust, maintained along haulage roads and on the intake-air side of wooden doors, at sufficiently frequent intervals to facilitate fire fighting.
- b. Water lines of adequate size installed along haulage roads. Water under sufficient pressure should be provided in the water lines for fire-fighting purposes. Hydrants or outlets should be provided at not more than 500-foot intervals.
- c. Enough fire hose provided and stored at several points in the mine where it can be readily obtained, preferably in intake air.
- d. A fire extinguisher approved for electrical fires provided on each locomotive, mining machine, and loading machine.
- e. Chemical fire trucks or water cars equipped with pumps and hose.
- f. Car or cars loaded with brattice cloth, lumber, tile, brick or cement blocks, suitable pipe fittings, tools and nails, and kept readily available in intake air.
- g. An underground fire-fighting organization. This organization should be instructed and drilled in fire-fighting procedure.

11.03. Fire extinguishers approved for electrical fires should be available at all electrical installations. If such extinguishers cannot be obtained, rock dust should be available.

11.04. Clean, dry sand or rock dust and fire extinguishers (if available), suitable from both a toxic and shock standpoint, should be provided and placed outside of underground electric stations so as to be out of the smoke in case of fire in the station.

Precautions

11.05. Underground storage places for lubricating oil and grease should be of fireproof construction.

11.06. Lubricating oil and grease kept in face regions or other working locations should be in portable, closed, metal containers.

11.07. Wood-lined shafts should be fireproofed; if it is not practicable to fireproof them, adequate protection should be provided against fire. Slope and drift openings should be similarly protected, as stated in standard 12.18.

11.08. Inside structures (substations, shanties, stables, pump rooms, etc.) should be of fireproofed construction, including doors. Where the fireproofing material is in contact with timber or coal, it should not be of metal.

11.09. Hay or straw should be transported from the surface to the underground stables in enclosed cars between shifts. It should be stored in a fireproof structure apart from the stable. Where practicable the stables should be located on the surface.

11.10. Underground stables should be ventilated by separate splits of air, with vents to the return air courses.

11.11. Welding and cutting (with electricity or flame) in gassy mines in face regions and on returns should be done under the immediate supervision of a certified official. No welding or cutting should be done if more than 0.5 percent of methane is present. In all welding and cutting operations, special precautions should be taken against starting a fire.

11.12. If feasible, power should be cut off from the entire mine on idle days, from sections of the mine during "off-shift" periods, and from sections of the mine where pillar falls are expected. This statement is not, however, intended to bar the use of lines, properly protected by fuses, for the operation of such units as pumps if all passageways and adjoining areas through which live circuits pass (including surroundings of units) are examined with a flame safety lamp and found free of gas.

12. MISCELLANEOUS

Mine Map

12.01. An accurate map of the mine, brought up to date at least every 6 months, should be posted in a convenient place accessible to employees.

12.02. The map posted at the mine should show, in addition to the mine workings:

- a. Direction of air currents passing through main headings, cross headings, and working places, by arrows in colors.
- b. Location of doors, overcasts, and regulators.
- c. Location of telephones, power and trolley lines, and permanent electric equipment.
- d. Sea-level datum elevations at reasonable intervals along main and cross entries.
- e. Location of oil and gas wells, high-pressure gas lines, and oil and gasoline lines.

Oil and Gas Wells

12.03. Oil and gas wells penetrating strata below beds of coal should be protected by a pillar of coal extending at least 50 feet from the well in every direction.

12.04. If oil or gas wells penetrate open workings:

- a. A surrounding wall or pier of cement, masonry, or concrete should be constructed of a diameter exceeding the height of excavation, or at least 48 inches.
- b. The casing should be surrounded by an outer steel casing extending 20 to 30 feet below the coal bed and open to the outside atmosphere for relief of any gas liberated.

12.05. Every oil or gas well penetrating a workable coal bed should be properly plugged from the bottom of the well to the surface when abandoned, and a record made thereof. If necessary, a 2-inch vent pipe should extend from at least 30 feet below the lowest coal bed to not less than 10 feet above the surface.

Protective Pillars

12.06. A 50-foot barrier pillar, or larger if deemed necessary, should be left when workings adjoin old workings suspected of containing bodies of

dangerous gas. If the danger is from water, the barrier pillar should be of such width as is determined by qualified engineers and approved by the proper State agency.

12.07. A pillar of suitable thickness should be left below each level to be maintained in coal beds pitching more than 30°.

12.08. Main slope and drift openings should be separated by at least 50 feet of natural ground. NOTE: This applies only to future openings.

Approaching Abandoned Workings

12.09. When a limit of 200 feet is reached from abandoned workings that cannot be inspected, or workings filled with water not in excess of a 150-foot head, or gas, boreholes should be kept at least 30 feet in advance of the face, and similarly, 45° angle holes at least 45 feet deep and not more than 8 feet apart should be made in each rib. If the head of water exceeds 150 feet, the depth of the boreholes should be increased 1 foot in length for each additional 10-foot head of water.

Mine Openings and Escapeways

12.10. In regard to mine openings:

- a. Every underground mine should have at least two separate outlets to the surface.
- b. Each bed of coal and each level or entry therein should have at least two travelable openings in connection with (directly or indirectly) both main outlets to the surface.
- c. It is not necessary that the two main outlets belong to the same mine if persons can travel safely to, and out of, either outlet from either mine.
- d. Not more than 10 persons should be allowed at any one time in a mine until connection has been made between the two main outlets.
- e. When only one main outlet is available, due to final mining of pillars, not more than 10 persons should be allowed in such mine at any one time.

12.11. Designated escapeways should be readily accessible from every section of the mine and should be kept in a safe condition, reasonably free from steam, dangerous gases, standing water, ice, and other obstructions.

12.12. If practicable, designated escapeways should be in intake air; if not in intake air, fire doors should be provided which can be closed tightly in an emergency to prevent smoke entering the escapeway.

12.13. Designated escapeways should be high and wide enough to allow men to travel safely.

12.14. Barrier gates that close automatically, or overpasses or underpasses, should be provided at places where manways cross haulageways.

12.15. Direction signs should be posted conspicuously to indicate manways and designated escapeways.

12.16. If the designated escapeways are shafts:

- a. They should be equipped with hoist and cage, or with a travel-able stairway, if more than 30 feet in depth.
- b. If equipped with stairway, it should be of substantial construction, set at an angle not greater than 45° with the horizontal, and equipped on at least one side with suitable handrail; landing platforms should be at least 2 feet wide and 4 feet long, at easy and convenient distances, and should be railed properly.
- c. If the shafts are not more than 30 feet deep, a ladder may be used in lieu of a stairway. Such ladders should be fastened securely. The rungs should be fastened securely, spaced equally, and not more than 15 inches apart.
- d. Ladders or stairways should be kept in good repair, with landings free of debris.

12.17. If a designated escapeway is a slope of more than 30° , it should be equipped with stairway or ladder and have landings at intervals not to exceed 50 feet.

12.18. If a designated escapeway is a drift or a slope inclined less than 45° from the horizontal, incombustible walls (or lining) should extend at least 200 feet from the entrance. If such designated escapeways do not meet these requirements, adequate fire protection should be provided.

12.19. If only one of the escapeways has incombustible walls or lining, it should be the normal intake airway.

12.20. All surface openings to underground workings that are not necessary for operation of the mine should be kept securely closed to prevent unauthorized persons entering, but they should be locked in such a way as not to prevent the escape of employees in an emergency.

12.21. All openings necessary for operation of a mine or for escape should be guarded against unauthorized entrance of persons, but so as not to prevent the escape of employees in an emergency.

Cap Lamps and Checking System

12.22. Only permissible electric lamps, preferably cap lamps, should be carried by all persons for illumination in a mine.

12.23. A check-in-and-out system should be adopted that will provide positive identification, upon the person, of every individual underground. An accurate record of the men in the mine should be kept in a place that will not be affected in the event of an explosion. Preferably, a metal identification check should be fastened to the belt of each employee.

Smoking

12.24. Smoking should not be permitted or practiced in any mine.

12.25. Search of employees for smoking material, matches, and other lighting devices should be made frequently and in a manner to assure that such articles are not being carried into the mine.

Protective Clothing

12.26. Protective hats should be worn by all employees, officials, and others while on duty in mines and also in work on the surface where there is danger from falling objects.

12.27. Protective footwear should be worn by employees, officials, and others while on duty in and around mines.

12.28. All men exposed to dust-inhalation hazards should wear permissible dust respirators.

12.29. Gloves should be worn when material is handled that may injure the hands.

12.30. Men should wear goggles or eye shields when exposed to hazards of flying particles. Where corrective-lens goggles are needed, they should be used.

12.31. Welders and helpers should be provided with proper shields to protect their eyes.

12.32. Haulagemen and others who work around machinery should wear snugly fitting clothing and have trouser legs held with boots or puttees, tucked inside socks, or otherwise fastened. When electric cap lamps are worn by such employees, the lamp cables should be concealed under their clothing.

Housekeeping

12.53. Good housekeeping should be practiced by all underground employees and officials; this includes not only the safe and efficient storage of supplies, cleanliness of underground structures, and removal of stumbling hazards along travelways, but it also includes the orderly storage of tools and materials in individual working places and the removal of flammable waste, protruding nails, and other scrap materials that may cause injury to workmen.

13. GENERAL SAFETY CONDITIONS

Supervision

13.01. The foreman or other person in charge of underground operations and all assistant foremen and fire bosses should have certificates of competency from the State if the State issues such certificates.

13.02. A record of foremen's certificates should be kept at the mine.

13.03. Shot firers, electricians, drillers, machinemen, and mechanical-loader operators should have certificates of competency from the State if the State issues such certificates.

13.04. Every mine should be examined for hazards before men, other than the examiner, enter the mine.

13.05. Each working place should be inspected for safety by a certified official at least twice each working shift and at such more frequent periods as may be necessary and practicable.

13.06. Idle or abandoned sections of a mine should be inspected for gas and other dangerous conditions by a foreman or fire boss immediately before other employees are permitted to enter such sections.

13.07. Air courses and accessible pillar falls should be traveled at least once each week by a certified mine official, who should leave his initials and the date; if any part or parts of the air course are in such condition that it cannot be traveled, the defective condition or conditions should be remedied promptly.

13.08. All entrances to dangerous places should be fenced off and suitable danger signs provided at safe distances from the existing hazard.

13.09. A statement of all dangerous conditions observed, including roof and timbering, should be recorded in ink daily in a book, signed and dated by the mine foreman and countersigned by the superintendent.

Safety Organization

13.10. A safety engineer or director should be employed for mines employing 100 persons or more.

13.11. A safety organization of officials and employees should be established if practicable.

13.12. A safety committee, including workmen and officials, should make periodic inspections of the mine and submit recommendations for correcting hazards observed.

Accidents

13.13. Accidents involving injury to persons and serious noninjury accidents should be investigated and a record kept of such investigations.

13.14. Responsibility for accidents should be placed, if it is feasible to ascertain such responsibility.

13.15. A record should be kept of all accidents involving loss of time beyond the day the accident occurred; these should be summarized monthly as well as annually and studied with a view to making needed corrections in practice.

Safety Meetings and Safety Rules

13.16. Safety meetings of men and officials should be held at least monthly. These meetings may consist of frequent short talks on safety given to the men in man-trips, in the sections, and on the surface.

13.17. Special company rules regarding mine safety should be adopted and supplied to the workmen; they should be approved by the State agency governing mining, where such approval can be obtained.

13.18. New employees should be fully instructed regarding the company safety rules and the particular hazards incident to their work; this applies to both experienced and inexperienced personnel.

13.19. Employees should become conversant with the State mining law with the aid of such instruction and assistance as may be obtained from the company or available educational agency.

13.20. A bulletin board should be provided and posted with suitable bulletins, if available.

First Aid and Mine Rescue

13.21. All employees (underground and surface) should be given first-aid training as soon as possible after being employed.

13.22. If feasible, additional first-aid training should be given to all employees annually.

13.23. Adequate first-aid material should be provided on the surface and underground and kept in clean, usable condition.

13.24. At least 10 sets of approved oxygen breathing apparatus and at least 6 approved gas masks and necessary accessories should be available in each mining district for use in case of mine fire or explosion. This equipment should be available at centrally located rescue stations owned by the State or operators in the district, or owned by individual companies. This equipment should be maintained in safe condition and readily available at all times.

13.25. When training facilities are available, at least 12 men should be trained in mine rescue work at mines having more than 100 employees; mines having 100 employees or less should have a proportionately smaller number trained.

13.26. Additional mine rescue training should be given monthly if training facilities are available.

13.27. Mine officials should take an advanced mine rescue course when such course is available.

13.28. Self-rescuers should be readily available to all underground employees.

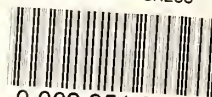
13.29. If self-rescuers are available, employees should be trained in their use. Self-rescuer cases should be maintained in airtight condition.

13.30. Procedures to be followed in the event of a mine explosion should be adopted and if desirable an outline thereof posted. Mine officials should be familiar with mine rescue and recovery methods.

13.31. Instructions in artificial respiration should be posted at every electrical station, and all employees working with or around electrical equipment should know how to give artificial respiration.

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